5. CONSOLIDATION SEWERS AND DROP SHAFTS

Forty-three combined sewer overflow (CSO) outfalls have been identified along Fall Creek and White River in the project area that require capture and diversion to the tunnel. This will be accomplished with the construction of consolidation sewers to collect flows from multiple outfalls, and the construction of drop shafts to convey the flow into the tunnel. As requested by the City of Indianapolis Department of Public Works (DPW), the consolidation sewers, diversion structures, and drop shafts will be sized for 99 percent capture of the CSOs. The CSO outfalls will be consolidated based on cost considerations and operations efficiency prior to connecting them to the main tunnel.

5.1 COMBINED SEWER OUTFALL FLOWS

The proposed CSO outfall consolidation and flow summary is presented in Table 5.1. Estimated flows in Table 5.1 were calculated for the White River CSOs using the Manning formula and full pipe flow, as indicated in the notes at the bottom of the table. The estimated flows for the Fall Creek CSOs indicated in Table 5.1 were provided by the DPW on September 2, 2004 based on hydraulic modeling performed by a consultant of the City. It has been indicated by the DPW that the City will further refine the flow estimates for both the White River and Fall Creek CSOs during future hydraulic modeling efforts for the selected level of CSO control.

5. CONSOLIDATION SEWERS AND DROP SHAFTS

Table 5.1
CSO Outfall Consolidation

Drop Shaft	CSO Outfall	Estimated Flow, mgd	Combined Flow, mgd	Pipe Length & Size Summary	Remarks
CSO 117	117[1]	125[2]	125	200 LF 96" Dia.	Pleasant Run CSO area flow would enter the tunnel near this point (99% capture rate = 919 mgd).
DS-01	12	11[3]	11	190 LF 36" Dia.	
DS-02	13	39[3]	142	360 LF 108" Dia. & 660 LF 72" Dia.	
	118	103[3]			
DS-03	115	81[3]	101	100 LF 108" Dia. & 830 LF 48" Dia.	
	116	20[3]			
DS-04	37	20[3]	51	990 LF 72" Dia. & 2440 LF 48" Dia.	Pogues Run CSO area flow will enter the tunnel near this point (99% capture rate = 1,900 mgd).
	38	11[3]			
	39	20[3]			
DS-05	40	11[3]	12	170 LF 36" Dia. & 410 LF 24"	
	147	1[3]			Suggest closing out CSO outfall 147.
DS-06	41	26[3]	26	60 LF 60" Dia.	
DS-07	42	11[3]	11	80 LF 36" Dia.	
DS-08	43	46[3]	51	350 LF 72" Dia. & 850 LF 36" Dia.	
	44	5[3]			
DS-09	45	93[3]	93	70 LF 96" Dia.	

5. CONSOLIDATION SEWERS AND DROP SHAFTS

Table 5.1
CSO Outfall Consolidation

Drop Shaft	CSO Outfall	Estimated Flow, mgd	Combined Flow, mgd	Pipe Length & Size Summary	Remarks
DS-10	49	7[4]	97	120 LF 84" Dia. & 390 LF 30" Dia.	Suggest closing out CSO outfall 049.
	210	90[4]			
DS-11	50	190[4]	305	110 LF 144" Dia. & 270 LF 84" Dia.	
	050A	115[4]			
DS-12	51	511[4]	614.6	620 LF 144" Dia., 1320 LF 84" Dia., 1870 LF 60" Dia., 470 LF 42" Dia., & 430 LF 24" Dia.	
	52	72[4]			
	53	13[4]			
	54	1[4]			Suggest closing out CSO outfall 054.
	55	3.6[4]			Suggest closing out CSO outfall 055.
	131	13[4]			
	132	1[4]			Suggest closing out CSO outfall 132.
DS-13	57	4[4]	99.31	290 LF 72" Dia., 280 LF 60" Dia., 100 LF 48" Dia.,350 LF 36" Dia., 320 LF 24" Dia.	Suggest closing out CSO outfall 057.
	58	6.31[4]			Suggest closing out CSO outfall 058.
	59	9[4]			
	60	34[4]			
	61	46[4]			
DS-14	62	421[4]	426	40 LF 144" Dia. & 700 LF 24" Dia.	
	213	5[4]			Suggest closing out CSO outfall 213.
DS-15	63	54[4]	73	30 LF 96" Dia.	
	63A	19[4]			
DS-16	64	11[4]	36	50 LF 60" Dia. & 200 LF 36" Dia.	
	142	25[4]			

5. CONSOLIDATION SEWERS AND DROP SHAFTS

Table 5.1
CSO Outfall Consolidation

Drop Shaft	CSO Outfall	Estimated Flow, mgd	Combined Flow, mgd	Pipe Length & Size Summary	Remarks
DS-17	65	229[4]	229	50 LF 120" Dia.	
DS-18	66	48[4]	48	1010 LF 48" Dia.	
DS-19	141	195[4]	195	350 LF 108" Dia.	
DS-20	135	162[4]	162	90 LF 108" Dia.	
DS-21	216	75[4]	75	660 LF 96" Dia.	

[1] Depending on the selected working shaft site, CSO outfall 117 may be dropped near the outfall or open-cut and dropped at the working shaft location.

[2] From Interplant Connection Facilities Planning Analysis Report, DPW Project CS-38-002A.

[3] Flow information by outfall was not available for CSOs along White River. For the preliminary design, flow has been estimated based on pipe diameter with gravity flow at 2.5 fps and a pipe roughness coefficient of 0.013.

[4] Estimated flows for the Fall Creek CSOs were provided by the DPW on September 2, 2004 based on hydraulic modeling performed by a consultant of the City.

Flows shown in Table 5.1 are the 99 percent capture peak instantaneous flows where they are available. This modeling effort has not been developed as part of this study, but was provided where available by DPW and the Clean Stream Team. In areas where flow information was not available, assumptions were made on the peak flow rates as described in the table.

Table 5.2 shows the existing diversion structure elevations along with the existing sizes of the pipes to the CSO outfalls.

5. CONSOLIDATION SEWERS AND DROP SHAFTS

Table 5.2
Existing CSO Outfall Information

Drop Shaft	CSO Outfall	Flow (mgd)	Regulator Invert	Overflow Elevation	Outfall Elevation	Outfall Size (inches)
CSO 117	117	125	667.95	673.68	668.14	60
DS-01	12	11	673.8	674.9	673.05	36
DS-02	13	39	679	681.6	677.93	66
	118	103	672.5	679.16	671.84	108
DS-03	115	81	681.36	685.51	680.35	96
	116	20	686.35	686.5	686.01	48
DS-04	37	20	685.43	690.95	679.24	48
	38	11	687.3	688.6	687.08	36
	39	20	679.09	682.78	675.2	48
DS-05	40	11	691.4	692.3	691.73	36
	147	1	683.2	683.6	681.9	12
DS-06	41	26	682.3	683.6	681.6	54
DS-07	42	11	688.98	689.56	676.27	36
DS-08	43	46	686.3	688.9	670.9	72
	44	5	685.15	687.15	685	24
DS-09	45	93	687.85	690.65	683.74	102
DS-10	49	7	687.6	688.7	685.3	24
	210	90	688.1	689.4	688.4	Unknown
DS-11	50	190	697.46	698.38	693.55	84 X 96
	050A	115	694.9	696	693.55	60X120
DS-12	51	511	697.5	698.76	696.6	96 x 144
	52	72	698.5	699.6	698	72
	53	13	700.39	702.39	699	51
	54	1	700.32	701	699.8	60
	55	3.6	702.12	702.99	695.96	21
	131	13	702.5	703.4	701.6	48
	132	1	700.7	701.8	700.7	36 x 78

5. CONSOLIDATION SEWERS AND DROP SHAFTS

Table 5.2
Existing CSO Outfall Information

Drop Shaft	CSO Outfall	Flow (mgd)	Regulator Invert	Overflow Elevation	Outfall Elevation	Outfall Size (inches)
DS-13	57	4	703.5	704	695.04	42
	58	6.31	702.91	703.58	696	42
	59	9	703.88	705.5	702.16	36
	60	34	706.73	707.5	707	50 x 70 Elliptical
	61	46	702.8	704.8	703.2	72
DS-14	62	421	706.67	709.72	706	120
	213	5	713.37	715.87	692.7	96
DS-15	63	54	704.77	705.4	699.99	60
	63A	19	701.8	704.8	700.65	108
DS-16	64	11	706.9	707.29	701.63	36
	142	25	706.79	708.415	704.89	102
DS-17	65	229	705.68	708.18	702.79	144
DS-18	66	48	706.5	707.49	705.98	48
DS-19	141	195	713.43	717.09	706.64	108
DS-20	135	162	710	712.3	703.39	108
DS-21	216	75	710.6	711.7	705	48

5.2 CONSOLIDATED SEWER AND DROP SHAFT PLAN

5.2.1 Methodology for Combining Sewers

As requested by DPW, the diversion structures and consolidation sewers will be sized for 99 percent capture of the 43 CSO outfalls along Fall Creek and White River. The following criteria were used to group the CSO outfalls for consolidation:

5. CONSOLIDATION SEWERS AND DROP SHAFTS

- Size and hydraulic capacity of the CSO outfall
- Minimize the number of deep drop shaft connections to the main tunnel thereby reducing the number of control structures
- Minimize the distance between the CSO outfall and drop shaft
- Possible location of emergency overflow structures
- Minimize easement requirements for consolidating sewers adjacent to and between the CSO outfalls for trenching, diversion structure construction, and shallow and deep drop shafts

For smaller CSO outfalls (approximately 7 million gallons per day (mgd) or less), it is recommended that the diversion structure divert 100 percent of the flow to the Fall Creek/White River Tunnel. Therefore, these CSOs to Fall Creek and/or White River would be eliminated completely.

At the time of this study, hydraulic modeling data was not available for the White River CSO portions of the project. Therefore, assumptions were made to determine the 99 percent capture flow for the associated CSO outfalls. A flow rate equal to the outfall diameter flowing full at a velocity of 2.5 feet per second (fps) was assumed for each CSO outfall located along White River.

The Fall Creek CSO outfall flow rates were based on preliminary hydraulic modeling results provided by DPW. The results were in the form of instantaneous flow at the various capture rates for each CSO. The 99 percent capture rates were used for the preliminary design of the consolidation sewers. As part of the ongoing hydraulic modeling effort, hydrographs will be developed to assist with the final sizing and design of the consolidation sewers. This model is currently being updated to provide additional information for future project phases. Based on the preliminary modeling information provided, there are several CSO outfalls with modeled instantaneous flow rates greater than the apparent capacity of the upstream pipe system at the 99 percent capture rate.

5. CONSOLIDATION SEWERS AND DROP SHAFTS

For preliminary design, CSO outfalls close in proximity were evaluated for grouping or service by an individual drop shaft. Pipes were sized assuming a velocity of 2.5 feet per second to be conservative in the design for smaller CSO outfalls. During future design phases, it may be possible to increase the slope of the pipe, increase the velocity in the pipe, and ultimately use a smaller diameter pipe for the consolidation sewers. Where the 2.5 feet per second velocity produced a pipe larger than 12 feet diameter, a higher velocity up to five feet per second was used to minimize the pipe size required. Once the consolidation sewers were preliminarily sized, further evaluation was made of possible drop shaft sites in their vicinity. Economic considerations were a priority to develop the least-cost consolidation sewers as possible. In some cases, adequate space was not available for a drop shaft, so consolidation sewers were extended to a more suitable location for the drop shaft.

Regulator structures and drop shafts have been located to provide accessibility for construction activities and operations and maintenance activities. In heavy traffic areas, drop shafts have been located to minimize traffic disruptions.

To minimize large debris from entering the tunnel, a stationary 6-inch square screen was included as part of each diversion structure prior to the drop shaft. A 3-inch bar screen will be provided prior to the Deep Tunnel Pump Station to remove smaller elements from entering the pumps.

5.2.2 Drop Shaft Considerations

Drop shafts are used to transfer CSO from the consolidation sewers to the tunnel under controlled hydraulic conditions and controlled air entrainment to prevent damage to the overall system. The three main elements of a typical drop structure are the inlet structure, vertical shaft barrel, and the energy dissipater/de-aeration chamber. The inlet structure provides the transition from horizontal flow to the vertical drop shaft. At the bottom of the drop shaft, a chamber is provided to withstand the impact forces, remove any entrained air, and to convey the water to the tunnel.

5. CONSOLIDATION SEWERS AND DROP SHAFTS

The high flow volumes and deep drops (more than 100 feet) expected for this project will require either a plunge drop or a vortex drop shaft configuration. High air entrainment and flow energy associated with deep drops eliminate a free-drop shaft option from further consideration. The final configuration of the drop shaft will be determined based on:

- System hydraulic modeling
- Shaft function
- Tunnel and shaft diameter
- Cost effectiveness
- Horizontal and vertical alignment of the tunnel
- Acceptable level of air entrainment and air movement in the tunnel
- Number of connections at each shaft
- Easements to accommodate drop structures and connections

Hydraulic modeling data will be used during design to establish the flow rates at drop structures and flow characteristics within the tunnel. The hydrographs to be developed for the tunnel system and the drop structure flow will be used to establish the air removal requirement. Air removal is an important consideration because air is entrained when the CSO flow is conveyed down the drop shaft. To prevent damaging high-pressure air buildups, release of odors, and a reduction in the tunnel's storage capacity, entrained air needs to be removed before entering the tunnel. Due to the need for air removal and anticipated high air flows exiting the larger drop shafts, odor control may be necessary.

The impact of the flow against the drop shaft floor of deep drops can be damaging if not cushioned. Typically, the impact is minimized by forcing a hydraulic jump within the shaft. This is accomplished by increasing the energy dissipation due to wall friction, entraining sufficient air to cushion the impact, and providing a plunge pool at the bottom of the shaft. Vortex drop configurations have a higher level of energy dissipation due to the increased wall friction associated with the helical flow pattern.

5. CONSOLIDATION SEWERS AND DROP SHAFTS

5.2.2.1 Plunge Drop Shafts

Flow from the consolidation conduits are collected in a regulating structure and directed to an inlet pipe. The flow enters and descends through the drop shaft. At the bottom of the shaft is a sloped-roof de-aeration chamber. As the air is released, it follows the sloping wall to the air vent side of the vertical shaft and rises to the surface. Energy dissipation is achieved through a pool of water inside the chamber. The pool is created through a restricted outlet (adit conduit) that is sized to control the level of the pool leading to the main tunnel. Based on lessons learned by the Metropolitan Water Reclamation District of Greater Chicago from the Tunnel and Reservoir Project (TARP), this plunge drop layout was economical for shaft diameters up to 9 feet with a maximum discharge of approximately 385 million gallons per day (mgd). For drop shafts larger than 9 feet in diameter, a separate shaft for the air vent with a horizontal roof chamber is more suitable (USACE, 1997). A typical plunge drop configuration is shown in Figure 5.1.

5.2.2.2 Vortex Drop Shafts

A typical vortex drop configuration is shown in Figure 5.2. The flow passes through an approach channel that induces laterally uniform flows before reaching the inlet. The inlet is designed to impart an angular motion to the flow before it enters the drop shaft. Potential vortex inlet configurations, including circular, scroll, spiral and tangential, are shown on Figure 5.3. The inlet induces a helical path and the flow remains in contact with the drop shaft wall with an air core at the center of the drop shaft. As a result of this flow pattern, vortex drop shafts entrain less air than plunge drop shafts. Although there is less air entrained in a vortex drop than a plunge drop, it is high enough to warrant de-aeration. At high flows, this structure can act much like a straight drop. Typically, the size of the de-aeration chamber will be smaller than that for a plunge drop. The air vent is located on top of the de-aeration chamber and removes entrained air from the tunnel.

5. CONSOLIDATION SEWERS AND DROP SHAFTS

Figure 5.1

5. CONSOLIDATION SEWERS AND DROP SHAFTS

Figure 5.2

5. CONSOLIDATION SEWERS AND DROP SHAFTS

Figure 5.3

5. CONSOLIDATION SEWERS AND DROP SHAFTS

Although not commonly used in the United States, another vortex inlet configuration is the helicoidal drop. This drop structure is used when there are space constraints. A helicoidal drop is more costly than the plunge or vortex drop structure. Due to space constraints not being an issue and the increased cost of the drop structure, it is recommended that no further consideration be given to the helicoidal drop.

5.2.2.3 Drop Shaft Locations

Potential drop shaft sites were identified and evaluated based on proximity to the CSOs, availability of adequate construction space, and consideration of public and environmental impacts. The 21 drop shafts and the drop for CSO outfall 117, if required, are identified on Figure 5.4. Appendix C – Consolidation Sewer and Drop Shaft Location Plans presents a more detailed view of each preliminary drop shaft site on high resolution aerial photographs. In addition, the drop shaft locations in relation to the consolidation sewer plan and associated CSO outfalls are discussed in greater detail later in this section of the report.

Drop shaft sites were determined at each site based on the size of the shaft and the working and staging areas needed to construct the shaft and the associated connection adits to the main tunnel. Some site areas were more constrained than others, which may increase the construction effort. However, these proposed sites are still of sufficient size to complete the work.

5.2.3 Consolidation Sewer Construction Considerations

This section describes the proposed locations of the consolidation sewers associated with each drop shaft including drop shaft property ownership, possible site access, and construction concerns. The figures referenced in this section are located in Appendix C – Consolidation Sewers and Drop Shaft Location Plans.

5. CONSOLIDATION SEWERS AND DROP SHAFTS

Figure 5.4

5. CONSOLIDATION SEWERS AND DROP SHAFTS

CSO Outfall 117

CSO outfall 117 is located near the working shaft for the main tunnel. This site is entirely on the public right-of-way as shown on Figure C-1. Therefore, right-of-way purchase is expected to be minimal. An access road to the diversion structure and shaft site is currently available. This site is immediately adjacent to the railroad and construction activities may be difficult at this location. Additionally, this site has large diameter sewers in the area, as it is adjacent to a White River sewer crossing. However, no conflicts are expected with the large sewers based on the site selected.

As the site is adjacent to the White River, additional dewatering is expected during construction.

Drop Shaft 01

CSO outfall 012 is an isolated outfall and will be the only CSO outfall diverted to drop shaft DS-01 for economic reasons. Since, the public right-of-way does not have adequate space to construct the diversion structure and drop shaft, property acquisition is required. This proposed shaft site is located on private property owned by Carter Truck Lines, Inc. and is adjacent to White River as shown in Figure C-2. Currently, the site is used for tractor trailer storage and has an adequate access road constructed from West Street. Since there are no known public utilities in the area, conflicts are anticipated to be minimal.

The City of Indianapolis owns property to the east of this shaft location. Based on this study, it appears that the selected site would be favorable because of increased cost by moving the shaft and consolidation sewer to the east. If there is a problem acquiring the preferred location, the City's property may be a reasonable alternative.

Drop Shaft 02

CSO outfalls 013 and 118 will be consolidated into drop shaft DS-02 as shown in Figure C-3. The proposed site is located on a triangular piece of property owned by

5. CONSOLIDATION SEWERS AND DROP SHAFTS

Merchandise Warehouse Company, Inc. on West Street. Space is not sufficient in the public right-of-way to construct the drop shaft. At this location, the concrete slope protection from White River extends near the edge of the White River Parkway. Dewatering during construction is anticipated as drop shaft DS-02 is located adjacent to White River. The proposed drop shaft site currently has adequate access for heavy truck traffic.

Drop Shaft 01 & 02 Combined

As a potential cost savings measure, the possibility of combining CSO outfalls 012, 013, and 118 to DS-02 was evaluated. Since CSO 012 has lower flows as compared to CSOs 013 and 018 it would be possible to connect the smaller 36-inch diameter pipe at the DS-01 location. However, this is in the area where detailed hydraulic modeling information is not currently available. A sensitivity analysis shows that a minor flow change to either CSO 012 or 013 after the current modeling is complete would make this a non cost-effective alternative. As a conservative approach, DS-01 and DS-02 will remain in the plan as shown.

Drop Shaft 03

CSO outfalls 115 and 116 will be consolidated into drop shaft DS-03. There are two 20-inch steam lines that parallel White River near CSO outfalls 115 and 116 as shown in Figure C-4. Hence, potential utility conflicts should be addressed during design of the consolidation sewers and drop shaft. The consolidation sewers were located to minimize encounters with the existing steam lines. One crossing will be required under the steam lines between CSO outfall 115 and drop shaft DS-03. The consolidation sewer for CSO outfall 116 is located approximately 20 feet east of the steam lines to minimize conflicts during construction. An allowance is included in the opinion of probable cost because of the unknowns related to this potential utility conflict.

5. CONSOLIDATION SEWERS AND DROP SHAFTS

Drop shaft DS-03 is proposed to be located on private property for access purposes, and the property is currently for sale. The property has no other improvements and access is available directly from McCarty Street.

Drop Shaft 04

Drop shaft DS-04 will collect the flow from CSO outfalls 037, 038 and 039 as shown in Figure C-5. This site is immediately adjacent to White River in an Indianapolis Parks trail area that is widely used and has had recent construction including the East Bank Tank project as well as the Indianapolis Central Waterfront project. The drop shaft was allocated in a flood zone area to limit impacts to the trail area. The selected site for drop shaft DS-04 is near the campus of Indiana University – Purdue University Indianapolis, and adjacent to New York Street. It is anticipated that modifications to the existing site and contours will be required to gain access during construction of the consolidation sewers that run adjacent to the trail. The proposed locations of the consolidation sewers should be evaluated as the project progresses to see if they can be moved to avoid this. Due to the close proximity of construction activities, the trail may need to be taken out of service until construction is complete. It has been assumed that the path will be replaced following construction of the sewers. With the tight proximity of the East Bank Tank, the proposed work, and the path, it may be difficult to construct this drop shaft and consolidation sewer grouping without temporarily relocating the path.

Drop Shaft 05

Drop shaft DS-05 will collect the flows from CSO outfalls 040 and 147, which are located along the White River Parkway. Figure C-6 shows this drop shaft location and associated consolidation sewers. Since, this site is currently owned by the City of Indianapolis, the acquisition of additional property for the drop shaft is not expected. The drop shaft and consolidation sewers have been located on the west side of the street to minimize traffic disruptions. CSO outfall 147 is small and is recommended for permanent closure as part of the Fall Creek/White River Tunnel project.

5. CONSOLIDATION SEWERS AND DROP SHAFTS

"Recommended Standards for Wastewater Facilities" (Ten State Standards) requires a 10-foot horizontal separation between sewers and water mains. There is an existing water main in the vicinity of the proposed drop shaft DS-05 location. It is recommended that additional right-of-way be purchased at this location to meet the distance requirements. Consideration should be given to the possibility of relocating the water line instead of purchasing property during the facility planning phase of the project. Placing the consolidation sewers east of White River Parkway or in a lane of traffic may be difficult at this site due to traffic considerations.

Drop Shaft 06

Drop shaft DS-06 will receive flow from CSO outfall 041 as shown in Figure C-7. To avoid traffic at the intersection of White River Parkway and Michigan Street, the diversion structure should be located on Michigan Street slightly upstream of the existing diversion structure and regulator. The site is situated on two lots owned by Illinois Cereal Mills, Inc. Currently, these sites are parking lots. Since the existing sewer main is located in the westbound lane of Michigan Street, traffic disruptions and possible detours will be expected for the duration of construction.

Drop Shaft 07

CSO outfall 042 will be conveyed to drop shaft DS-07 as shown in Figure C-8. This site is currently owned by Reilly Industries, Inc. and is part of a driveway/parking area. The site may be accessed from St. Clair Street. Since no access is provided to White River Parkway from St. Clair Street, construction traffic will need to be directed through a residential area during construction unless access can be secured to use the maintenance access roads instead.

Drop Shaft 05, 06, and 07 Combined Alternative

CSO outfalls 040, 147, 041, and 042 were evaluated in several combinations to determine if there would be a savings by combining either DS-05 and DS-06, or DS-06 and DS-07, or all three. These CSO outfalls are in the area where there is inadequate information concerning the 99% capture rate. While there does appear to be savings by combining all three into the DS-06 location, the costs are maintained due to the uncertainty of the flow data. Sensitivity analysis shows that the pipes as sized would indicate this to be a cost-effective option. However, if the pipe sizes were to increase, the savings would not be realized and it would be more cost effective to revert to the drop shaft locations as indicated.

Drop Shaft 08

Drop shaft DS-08 will consolidate the flows from CSO outfalls 043 and 044. The shaft site is located in the Bush Stadium parking lot along Waterway Boulevard as shown on Figure C-9. The stadium is owned by the City and is currently used as parking for IUPUI shuttle buses. CSO outfall 044 is a smaller CSO and could be closed if hydraulic modeling confirms that the flow is negligible. This site is expected to sustain construction activity for at least three years as it is proposed as an intermediate working shaft site for the West Tunnel Alignment.

Drop Shaft 09

CSO outfall 045 is the only CSO anticipated for conveyance to drop shaft DS-09. CSO outfall 046 is approximately 4000 feet upstream, but is proposed for sewer separation and is not included in the Fall Creek/White River Tunnel project. Figure C-10 shows the location of the drop shaft in a park area owned by the City. The diversion structure can be constructed just off the edge of White River Parkway, which should cause only minimal disruption to traffic in the area.

This site is being transferred to the Indianapolis Public Schools for the construction of a school. If the school construction will interfere with the construction of the drop shaft, or the safety of the children as the project progresses, it may be necessary to find an alternate location.

5. CONSOLIDATION SEWERS AND DROP SHAFTS

Drop Shaft 10

Figure C-11 shows the consolidation of CSO outfalls 049 and 210. These CSO outfalls are on opposite sides of Fall Creek. The construction of the crossing should be performed during periods of low flow in Fall Creek. The drop shaft is in an area owned by Indianapolis Parks. In order to minimize traffic disruption on Stadium Street, the 84-inch diameter street crossing should be made by bore and pipe jack method. Alternatively, the consolidation sewer could be installed in one traffic lane at a time while rerouting traffic. This drop shaft site was chosen because of water lines located on the same side of the road as CSOs. It may be possible to relocate these water lines and construct the drop shaft and consolidation sewers on the same side of the road, but this would likely mean that water lines would need to be relocated creating similar traffic problems due to construction.

There is a possibility that CSO outfalls 049 and 210 will be separated if the proposed West Tunnel Alignment is chosen. A cost evaluation for separation versus the extension of a connector tunnel from drop shaft DS-10 to the main tunnel should be included in the next phase of the project if the West Tunnel Alignment is selected.

Drop Shaft 11

CSO outfalls 050 and 050A are consolidated into drop shaft DS-11 as shown in Figure C-12. This drop shaft and consolidation sewer construction will be in green space adjacent to Fall Creek.

Drop Shaft 12

Drop Shaft DS-12 has the largest number of CSO outfalls to be consolidated as shown in Figure C-13. It includes CSO outfalls 051, 052, 053, 054, 055, 131 and 132. This is the largest consolidation sewer with a total anticipated flow of 615.6 mgd. Only CSO outfalls 055 and 132 are considered small enough for closing, thereby directing all flow to the main tunnel. This long run of consolidation sewers is planned because of limited potential shaft sites in this area. In the facility planning phase of the project, it may be possible to purchase a property with an existing structure appropriate for demolition and minimize the length of the consolidation sewers in this grouping.

The drop shaft is located in green space owned by the City. Much of the construction can be completed in the green space adjacent to Fall Creek Parkway without traffic disruptions. The largest traffic disruption will be at the crossings of Capitol Street, Illinois Street and Meridian Street where CSOs and the main sewer line are located in the center of the street. The diversion structure for these CSOs is unable to be located in an area that prevents construction work in these streets. The consolidation sewer for CSO outfall 051 is a 144-inch diameter pipeline that must cross Fall Creek. This construction should be accomplished during periods of low flow in Fall Creek. Annually in the summer, typical water surface elevations are such in the Creek that construction of a coffer dam would allow open-cut construction. As the project progresses in the design stage, regulatory approval of this approach should be started early. Otherwise, alternate construction methods may have to be used to complete the crossing.

Drop Shaft 13

CSO outfalls 057, 058, 059, 060 and 061 are consolidated into drop shaft DS-13 as shown on Figure C-14. This site is owned by the City. Three of these CSO outfalls (057, 058 and 059) are candidates for closure based on their low flows. Most of the consolidation sewer construction will be parallel to Fall Creek Parkway approximately 15 feet off of the roadway. Since CSO outfall 060 is on the opposite side of Fall Creek, it will need to be constructed during periods of low flow in order to perform the creek crossing. The Fall Creek crossing should be addressed in the facility planning stage of the project to determine the acceptability of making an open-cut crossing of Fall Creek during low flow periods.

5. CONSOLIDATION SEWERS AND DROP SHAFTS

Drop Shaft 14

Figure C-15 shows the consolidation of CSO outfalls 062 and 213 at drop shaft DS-14. There is an existing easement that runs from CSO outfall 213 to 062 behind a residential area. It is expected that the 24-inch sewer can be constructed in this area. The drop shaft will be located on two properties owned by Stephanie D. Sears and R.J. Enterprises, LLC. CSO outfall 213 is a small outfall that may be closed and all flow directed to the tunnel. This should be verified in future project phases using the hydraulic model. Traffic disruptions should be minimal for the construction of drop shaft DS-14. The relatively small size of this consolidation sewer may allow for some alternate construction methods that may minimize traffic disruption.

CSO 213 outfall is 96 inches in diameter. The 99% capture flow provided for this report is listed as 5 mgd, which is a relatively low flow through the CSO as currently modeled. Typically the new consolidation sewers were sized to be no smaller than the existing CSO outfall. This was preliminarily sized to be 24-inch diameter because of the difference in the flow under current conditions. There is a flood wall in the immediate vicinity of the proposed combined sewer. If the model indicates the flow from CSO 213 is substantially higher than the 5 mgd indicated, it would likely be necessary to add a drop shaft in the area of CSO 213, which has limited space available.

Drop Shaft 15

Drop shaft DS-15 consolidates the flows from CSO outfalls 063 and 063A as shown on Figure C-16. The existing diversion structures are in the Fall Creek Parkway. In order to minimize traffic disruptions, the flow should be captured prior to the existing diversion structures.

Drop Shaft 16

CSO outfalls 064 and 142 are combined at drop shaft DS-16 as shown in Figure C-17. This site, as well as the locations for the consolidation sewers and diversion structures, is owned by the City. Traffic disruptions and utility conflicts are expected to be a minimal because the site is 120 feet from Fall Creek Parkway.

An evaluation was made to determine if DS-15 could be eliminated by combining the flow from CSO 063 and 063A at DS-16. The evaluation indicated that it would cost more than the current plan.

Drop Shaft 17

Drop shaft DS-17 collects flow from CSO outfall 065, as shown on Figure C-18. This structure will be large since the 99 percent capture flow is anticipated to be approximately 229 mgd. This site is adjacent to the abandoned railroad that is now part of the Monon Trail. Locating drop shaft DS-17 adjacent to the trail will disrupt its use during construction. The adjacent commercial property could be used for construction access and continual operation and maintenance. Since the diversion structure for this site is at the corner of 34th Street and property owned by others, it is possible to select another drop shaft location adjacent to the railroad tracks. Another drop shaft location may be necessary if design issues occur due to lack of access during construction, or from potential odor issues. Odor control is discussed in detail in Section 8 – Project Considerations. In most cases, the trail will not be used during wet weather when flow would be discharging to drop shaft DS-17.

Drop Shaft 18

Drop shaft DS-18 will carry the flow of CSO outfall 066 to the Fall Creek/White River Tunnel. This drop shaft site is on a parking lot owned by the Indiana State Fair Commission and is shown in Figure C-19. Unfortunately, the drop shaft cannot be located close to the existing diversion structure due to the lack of adequate space above the flood plain at the intersection of Balsam and Fall Creek Parkway, and lack of suitable land area for constructing the drop shaft. The diversion structure cannot be relocated closer to the drop shaft as flows from multiple collection lines merge at the proposed location. A thorough evaluation should be done in the facility planning stage to see if it would be possible to construct the drop shaft adjacent to Fall Creek and the proposed tunnel location.

Drop Shaft 19

Drop shaft DS-19 will collect the flow from CSO outfall 141. The proposed drop shaft site shown in Figure C-20, is near a major intersection of Fall Creek Parkway and 38th Street. Drop shaft DS-19 is proposed to be located in a parking lot owned by the State of Indiana. The CSO diversion structure is located in the northwest corner of the intersection of Fall Creek and 38th Street.

Consideration was given to placing the drop shaft in the area immediately adjacent to Fall Creek, but it is thought that there is inadequate space to construct the drop shaft there. This should be thoroughly evaluated in the facility planning stage and done if possible.

Drop Shaft 20

The site for drop shaft DS-20 is owned by the Carson Corporation. Drop shaft DS-20 will convey the flow of CSO outfall 135 to the main tunnel as shown in Figure C-21. Traffic disruptions should be minimal and site access is available from 39th Street.

Drop Shaft 21

CSO outfall 216 will be discharged at drop shaft DS-21, which is located adjacent to Fall Creek Parkway as shown on Figure C-22. This is a narrow site that is approximately 30 feet wide. If this proposed site can be used, additional rights-of-way would not be required since the site is owned by the City. Clearing of this site will be required.

Table 5.3 summarizes the information included herein and on the figures located in Appendix C – Consolidation Sewer and Drop Shaft Locations.

5. CONSOLIDATION SEWERS AND DROP SHAFTS

Table 5.3
Consolidation Sewer and Drop Shaft Summary

Figure No.	Drop Shaft	Preliminary Consolidation Sewer			Drop Shaft Site Property Owner
		Location	Diameter, in	Length, LF	
C-1	CSO outfall 117	CSO 117[1]	96	200	Publicly Owned
C-2	DS-01	CSO 012 to DS-01	36	190	Carter Truck Lines
C-3	DS-02	CSO 013 to DS-02	72	660	Merchandise Warehouse Company
		CSO 118 to DS-02	108	360	Merchandise Warehouse Company
C-4	DS-03	CSO 115 to DS-03	108	100	Linda Goetze
		CSO 116 to DS-03	48	830	
C-5	DS-04	CSO 037 to CSO 038	48	1290	IUPUI
		CSO 038 to CSO 039	48	1150	
		CSO 039 to DS-04	72	990	
C-6	DS-05	CSO 040 to Short Connection Sewer	36	80	City of Indianapolis
		CSO 147 to Short Connection Sewer	24	410	
		Short Connection Sewer to DS-05	36	90	
C-7	DS-06	CSO 041 to DS-06	60	60	Illinois Cereal Mills, Inc.
C-8	DS-07	CSO 042 to DS-07	36	80	Reilly Industries, Inc.
C-9	DS-08	CSO 043 to Short Connection Sewer	72	170	City of Indianapolis
		CSO 044 to Short Connection Sewer	36	850	
		Short Connection Sewer to DS-08	72	180	
C-10	DS-09	CSO 045 to DS-09	96	70	City of Indianapolis
C-11	DS-10	CSO 049 to CSO 210	30	390	City of Indianapolis Parks
		CSO 210 to DS-10	84	130	
C-12	DS-11	CSO 050A to CSO 050	120	270	Marion County
		CSO 050 to DS-11	144	110	

5. CONSOLIDATION SEWERS AND DROP SHAFTS

Table 5.3
Consolidation Sewer and Drop Shaft Summary

Figure No.	Drop Shaft	Preliminary Consolidation Sewer			Drop Shaft Site Property Owner
		Location	Diameter, in	Length, LF	
C-13	DS-12	CSO 051 to DS-12	144	620	City of Indianapolis
		CSO 055 to CSO 132	24	430	
		CSO 132 to CSO 054	42	470	
		CSO 054 to CSO 053	60	690	
		CSO 053 to CSO 131	60	640	
		CSO 131 to CSO 052	60	540	
		CSO 052 to DS-12	84	1320	
C-14	DS-13	CSO 057 to CSO 058	24	320	City of Indianapolis
		CSO 058 to CSO 059	36	350	
		CSO 059 to DS-13	48	100	
		CSO 061 to DS-13	72	290	
		CSO 060 to DS-13	60	280	
C-15	DS-14	CSO 062 to DS-14	144	40	Stephanie D. Sears and R.J. Enterprises, LLC
		CSO-213 to DS-14	24	700	
C-16	DS-15	CSOs 063 & 063A to DS-15	96	30	Missionary Baptist Church
C-17	DS-16	CSO 064 to CSO 142	36	200	City of Indianapolis Parks
		CSO 142 to DS-16	60	50	
C-18	DS-17	CSO 065 to DS-17	144	50	City of Indianapolis
C-19	DS-18	CSO 066 to DS-18	96	1010	Indiana State Fair Commission
C-20	DS-19	CSO 141 to DS-19	108	350	State of Indiana
C-21	DS-20	CSO 135 to DS-20	108	90	Carson Corporation
C-22	DS-21	CSO 216 to DS-21	96	660	Indiana State Fair Commission

[1] CSO outfall 117 will be conveyed to a drop shaft if required.

5.3 SITE ACCESS

Site access is not considered to be a major concern for the proposed drop shaft locations, because access should be available during construction activities. Additional access will be required for construction of the consolidation sewers and for operation and maintenance of the structures. Although the proposed sites were selected to minimize disruptions and provide access for equipment, material delivery and disposal of materials, they may interfere with existing traffic patterns and require rerouting. As part of the design for each of these sites, an allowable traffic pattern should be established in sensitive areas. Locating disposal sites for excess material near each site prior to bidding the project may assist in limiting further traffic delays during construction.

Working Shaft

The Bluff Road working shaft site has acceptable access for use by continuous heavy traffic. This site will be used for approximately 10 years. Repairs to the existing access road may be required due to the traffic load over this extended period of time. Budgetary allowances have not been made for road repairs. The repairs should be considered a part of the Contractor’s responsibility to maintain the construction road for use by Contractor traffic.

In addition to site access, the effects of heavy truck traffic on Bluff Road and adjacent streets should be evaluated during design. It is anticipated that repairs will be necessary over the course of the project. Routing for material disposal has not been determined and road repair expenses over a determined length cannot be anticipated.

Intermediate Shaft

The intermediate shaft site may be in use for the 10-year project length if two contracts are required for the project. There may be continual truck traffic requiring the removal of tunnel spoils. If the project is constructed as a single contract, this site would need to be utilized for a reduced period of time.

Retrieval Shaft

This site is planned for the Sutherland Avenue location. The site can be accessed by existing stone roads. This site is expected to be in active construction use for about one year.

5. CONSOLIDATION SEWERS AND DROP SHAFTS

5.4 PIPE DESIGN CONSIDERATIONS

While a more detailed assessment is required, preliminary recommendations for pipe materials and general specifications are indicated below. The pipe recommendations were taken from the Clean Stream Team October 24, 2003 Draft Specifications and Indianapolis DPW 1989 Specifications. These preliminary design considerations are based on these standards. As the design progresses, right of way requirements, site specific issues, geotechnical issues, and cost considerations may require specific materials to be used for the pipe, backfill, and other construction materials.

- Dependent on soil type, construction, and the larger diameter consolidation sewers, reinforced concrete pipe (RCP) with a plastic liner would be recommended. For smaller diameter consolidation sewers Polyvinyl Chloride Pipe (PVC), Ductile Iron Pipe (DIP), Truss Pipe, and High Density Polyethylene Pipe (HDPE) may be considered as an alternate pipe material based on information provided in the draft Clean Stream Team Specifications
- The concrete sewer pipe should comply with ASTM C76 and C655
- Granular pipe embedment material should be Indiana Department of Transportation (INDOT) Size No. 11 or 12 crushed stone. The pipe should be bedded on crushed stone and rock. Sufficient embedment material should be deposited around the pipe up to the pipe springline after placement
- Flowable fill may be used in areas under roadways, or as determined otherwise during the detailed design phase of the project